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Rural Industries Research and Development Corporation

# Paprika

*A Scoping Study of the Market and Value Chain*

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Structured Portfolios Pty Ltd

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# Foreword

An increased demand for natural spices and colorants has expanded the demand for high quality condiment paprika worldwide. Hungary has produced high quality condiment paprika in the past. By using Hungarian cultivars and other genetic material in a breeding program for Australia it is hoped to establish a viable condiment paprika industry in Australia.

The world supply of paprika in recent years has changed significantly. Supply is polarised into that from production systems in countries which operate with cheap labour inputs, and that which adopts a high degree of mechanisation to replace labour plus value-add production.

Australia faces significant challenges if a viable industry is to be established. This project aims to identify some of the settings required for such development. Recently in New Mexico and Israel, there have emerged, examples of high labour cost countries demonstrating competitiveness through implementation of higher mechanisation, value-add and product quality differentiation. If Australia is to be competitive it seems apparent that it must adopt industry models which address the realities of the marketplace and respond with innovation at all levels within the value chain.

A further aim is to anticipate some of the characterising features of a potentially emergent industry in terms of regional production centres, degree of connectivity within the value chain such as vertical integration of growing production and processing, and parameters for end market products. By seeking to identify these features it is anticipated that there will be some guidance for the direction of any future investment.

This project was funded from RIRDC core funds which are provided by the Australian Government.

This report is an addition to RIRDC's diverse range of over 1800 research publications. It forms part of our New Plant Products R&D sub-program which aims to facilitate the development of new rural industries based on plants or plant products that have commercial potential for Australia.

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**Peter O'Brien**
Managing Director
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# Executive Summary

**What this report is about**

RIRDC has previously funded projects principally associated with condiment paprika breeding, including US-116A. RIRDC is now looking beyond the elemental focus of the breeding program and is considering the broader aspects of the industry, value-chain and international settings in which it operates.

This project is a first a first step in establishing some of the parameters which are critical to the establishment and further development of potential growth of a competitive value-added paprika growing and processing industry. A number of challenges are identified to secure viable industry growth.

**Target Readership**

The report intends to inform the Corporation of potential strategic paths, and potential paprika growers, breeders and processors of paprika of our progress towards the goal of providing the industry with superior material and market access. In addition, we wish to inform these same groups of opportunity elements within the value-chain.

**Objectives**

Broadly, the report discusses:

- if a market for paprika oleoresin exists in Australia that could be supplied by Australian producers and processors allowing profits along the value chain.
- what current and relevant (to production and processing of oleoresin) infrastructure exists that could be coordinated into an effective value chain proposition.
- gaps and obstacles that need to be overcome before an efficient and cost effective oleoresin production and processing system can be established.
- opportunities in development of hybridisation systems for paprika and the broader markets of capsicum - Bell etc.

**Methods Used**

The study comprised an extensive degree of desk research to establish some of the primary drivers of production and the necessary preconditions for a vibrant industry.

The key elements were gaining a perspective of the international production and trade associated with paprika, and identifying the differences between the various value-chains to enable some degree of analysis of system applicability to Australian settings. This work was supplemented by discussions with a limited number of industry participants to gauge further perspectives.

**Results**

The Paprika growing and processing industry is beset with challenges, uppermost include:

- a need to facilitate labour saving technologies throughout the production cycle, especially at harvest to reduce costs. There is a limited availability of standard paprika harvesting equipment in Australia, however overseas experience has developed effective machines. In Australia most equipment may be regarded as advanced final prototype adaptations of other purpose built devices e.g. converted tomato harvesters or cotton harvesters.
- there is a need for aggregation of crop production to value-added processing centres, as a potential model for an industry to develop
- there is a need for differentiation of products to improve marketability – based on quality characteristics and bio-safety considerations

- International competition
- Australian environmental factors – water, drought
- Australian economic factors are not entirely favourable under a high value currency scenario, however this may be a mixed blessing with the need to import high value equipment.

*Networking opportunities*

During the course of this project a small number of individuals have indicated a desire to consider some involvement in further developments and intend to participate in further discussions to gauge collaborative interest.

**Recommendations**

To date there has been a primary focus on developing suitable paprika cultivars for Australian conditions. In order to consider establishment or development of a viable paprika growing and processing industry, the focus should now consider the pre-conditions under which such an industry can survive, be competitive and thrive.

In order to identify future actions, a few key assumptions can be made which may assist in assignment of future priorities. Firstly, that any industry associated with paprika growing and processing will be targeted at the top end value-added market sector for terms of quality; will require high use of technology; and will target higher priced markets. Secondly, a substantial degree of vertical integration of the operating functions is necessary to gain sufficient economic efficiencies to be viable. The model is likely to favour an outcome whereby operations may possibly be delivered via a single region, rather than fragmented.

If the above scenario has merit, then a key priority is to identify the most likely region in which to establish prior to any decision to commit to any substantial investment.

Thus, the next phase of development for RIRDC to consider in its portfolio funding priorities should be focused on the relatively fundamental settings in which a paprika growing venture may require, in particular, identifying "location".

1. Viability trials - germplasm

- Conduct a small number of regional grow-out trials to identify locations of suitability which can be tested using currently available cultivars and advanced lines.

  Initially, it was to be expected that any large scale paprika growing may have been an adjunct to other capsicum growing centres. This may not be the case, and paprika may instead be a solution for niche diversification for a small number of cotton operators in the NW of NSW as a possibility.

  Any grow-out trials will offer the opportunity to re-evaluate (G x E) genotype x environment interactions for quality and yield. These trials need only to be relatively small. However, the greater number of potential targeted areas will be beneficial.

2. Viability Trials – Processing Technologies

- More trials associated with processing technologies of dried paprika are required to identify suitability and likely value-added end products.

  The advantage of this type of trialling often promotes network building and interest.

3. Other Actions –

- Facilitate a networking opportunity for participation by principals of the key elements:
    - growing
    - processing
    - marketing

- Aim to identify a development "champion" or key driver of the concept of creating an industry or group capable of formation of a viable joint venture. Industry "pull" is seen as more effective than germplasm "push".

  There is no shortage of individuals in the agriculture industry to invest in risk enterprise and innovation. Rather, there seems to be an apparent shortage of those able to present to decision makers the appropriate value propositions for them to act.

  Under the above scenario there is less emphasis on developmental plant breeding aimed at producing specific cultivars with particular traits, in preference to assisting with getting an industrialised system operating.

  However, a move towards an industrialised systems approach means that all inputs and outputs will require a level of due diligence and scrutiny to improve the total design. Plant breeding will focus on specific trait design specifications relevant to specific requirements or adaptations for known locations and environments.

4. Breeding Methodologies – tissue culture methods

   Consideration could be given to fund programs where there are substantial pay-offs for success, and in particular, where there is likely to be a flow of benefits to other closely related activities. The development of effective tissue culture methods would significantly reduce the costs associated with the commercial production of hybrid crops. Once optimal heterotic combinations of parental materials have been established, the F1 progeny could be greatly increased through cell culture to produce seedlings for direct transplant.

   A program focused initially on paprika could make substantial changes to viability, and if successful could readily be extended to other capsicum and chilli species.

   .

# Introduction

To-date much of the strategy for participation in the paprika industry has focused on breeding of new "quality enhanced" cultivars with the expectation that a commercial entity will emerge to deliver to them to the industry. This may no longer be a primary objective to secure industry growth.

There are significant movements (and flux) in the international market to recognise that opportunity windows are present and trends which can be ridden. For instance, previously funded projects such as the RIRDC project US-116A and extension identified machine harvest-ability as a key constraint to the expansion of paprika production in Australia. This is because Australian labour costs are high and growers are unable to compete with low-cost labour in Africa, Asia and South America, should hand harvesting be required.

The breeding and research program was therefore focused on developing machine harvestable germplasm and cultivars.

To develop a competitive paprika industry higher productivity is required. The key areas in which to focus include:

- Introduction of labour reducing technologies, by:
  - use of specially adapted purpose built for paprika harvesters
  - use of specialised equipment requires growing equipment compatible cultivars. These cultivars should contain appropriate traits for "detachability" for removal of fruit by snap-off pedicel to facilitate higher harvested yield. They should ideally have determinant habit, producing fruit during a defined stage of development, rather than gradually over a long period of time.
- Adoption of the advanced methodologies being employed in the third generation production systems as may be found in North America, particularly in New Mexico which is undergoing a re-birth of competitiveness since responding to industry challenges, in particular reducing labour costs.
- Formation of more efficient economic units of production and networks which are designed to capture an increased share of available value-chain margins.
- Investigation of effective methods and introduction of cost savings in production via cloning technologies to reduce cost of imported hybridised seed.

# The International Market

## Structure and location

The structure of the international paprika market is somewhat polarised by varying production methodologies which is largely determined by labour cost as a primary separator, and further differentiated by whether a country is a grower, grower value-adder and marketer of finished products.

The principal markets for paprika are:

- North America
- European Union

these account for about 60% of world imports.

The highest exporters are:

- China and
- India, with
- Spain and Peru competing for 3rd, and then
- Zimbabwe and rest of Africa.

The highest importers of the product are:

- USA and Mexico in the Americas
- Germany, Spain and the Netherlands in European Union, and
- Malaysia, Japan and South Korea in Asia

## Current production trends and any new areas going into production

The principal production trends are:

Downside:

- Significant declines in Zimbabwe production over the last several years as a result of political instability, and the exit of some of the key resources to sustain the industry (skill and financial).
- Some declines in US mainly due to drought impacts in recent years.

Upside:

- Emergence of Peru as an important participant as a supplier to north America in product, together as a seed producer

  The growth of the Peruvian industry has been significant for the period 2000-2005, revenues for dried or ground paprika increased from US$5.9, to US$95.3m, representing an annual growth rate of about 85%. A significant factor in this growth has been a Free Trade Agreement with the USA. The production levels of 2004-5 represent about 9-10% of world supply.
- Re-birth of competitiveness southern states of USA such as New Mexico on the back of addressing the realities of needs for responding to marketplace changes and implementing an increased degree of mechanisation within the production cycle.

## Supply chain and models

The supply chain and models under which various countries operate vary significantly and to a large extent reflect one of the main input issues, that of labour multipliers.

Indicatively, approximated relative labour cost ratios include:

- Africa 1 to 4
- Peru 2
- China and India 2 to 4
- Mexico and Chile 4
- Israel and France 18
- Spain 22
- North America 32

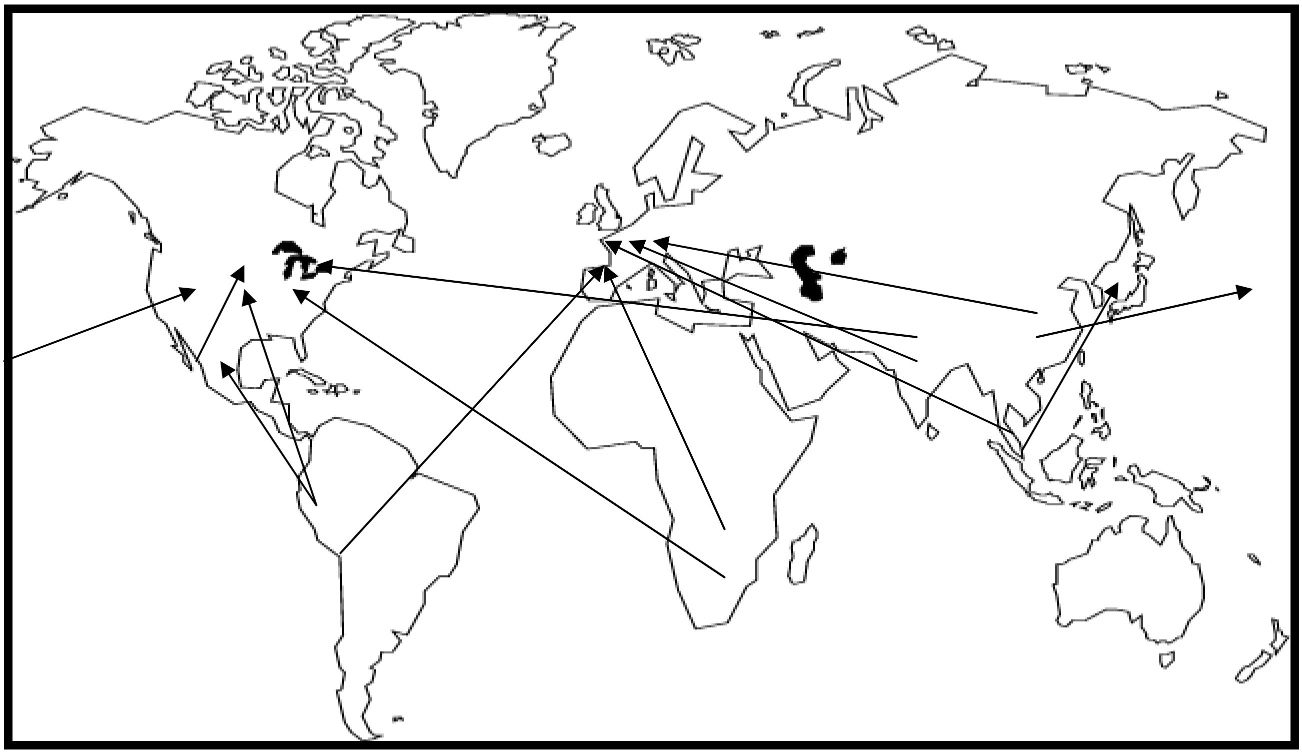


***Figure 1. Map of Major Export Flows***

Whilst relative labour costs are important, there are other factors relating to competitiveness of supply include:

- farm size / scale
- degree of use of mechanisation – including trade-off of labour cost and harvested percentage of potential yield and yield loss due to unrecoverable yield with mechanised approaches
- farming management methods – irrigation, use of herbicides, pesticides and fertiliser to increase yields
- quality of germplasm
- inbred vs hybrid seed
- energy availability and costs
- degree of value-add (processing)

## Main issues being faced in these overseas markets

Overseas markets are beset with several and differing issues affecting profitability. There are always labour pressures and a tendency for major networked corporations to divert or seek to divert sourcing production to the low or lowest cost producers.

It would also appear that with the emergence of China and India as significant suppliers there are increased concerns with quality issues, including residues from chemical pesticides and other contaminants. These are of particular concern in the major European and USA markets.

Reliability of supply is also an issue, particularly as total demand increases. There is a relatively high correlation between the cheapest sources of labour and political instability.

## Export potential for Australian producers

With total demand increasing there are two main opportunities for export, all of which require value-added processing:

- paprika – high quality ground
- paprika oleoresin

In order to achieve export markets it is likely to require a significant degree of production network creation to create sufficient market pull and provide incentives for growers to be confident of a local Australian farm gate cash market.

## Market perspective - production

World production of oleoresins is somewhat complex to identify from available trade statistics. This is due to the merging of data which details "Imports of Paprika", "Imports of Paprika Oleoresin", "Export of Paprika Oleoresin" but does not account for domestic usage of the production. The statistics are further complicated through processing and reprocessing.

***Table 1. Importing Countries of the Commodity "090420", Fruits of the Genus Capsicum, (including cayenne pepper, paprika & red pepper) or of the genus Pimenta ( including allspice), dried crushed or ground - Year 2002***

**Principal Importers**

| Country | Volume (t) | % of World |
|---|---|---|
| **World** | 309,509 | 100% |
| **USA** | 85,197 | 27.5% |
| **Mexico** | 19,050 | 6.2% |
| **Canada** | 5,006 | 1.6% |
| **UK** | 6,109 | 2.0% |
| **Spain** | 25,492 | 8.2% |
| **Netherlands** | 6,655 | 2.2% |
| **Germany** | 16,743 | 5.4% |
| **Thailand** | 14,705 | 4.8% |
| **Sri Lanka** | 25,317 | 8.2% |
| **Malaysia** | 40,140 | 13.0% |
| **S Korea** | 7,847 | 2.5% |
| **Japan** | 9,962 | 3.2% |
| **Indonesia** | 7,315 | 2.4% |
| **Australia** | 1,926 | 0.6% |
| **Rest of World** | 38,045 | 12.3% |

**Principal Exporters**

| Country | Volume (t) | % of World |
|---|---|---|
| **World** | 309,509 | 100% |
| **Brazil** | 7,065 | 2.3% |
| **China** | 84,261 | 27.2% |
| **India** | 60,292 | 19.5% |
| **Indonesia** | 11,810 | 3.8% |
| **Mexico** | 31,140 | 10.1% |
| **Peru** | 15,032 | 4.9% |
| **South Africa** | 8,061 | 2.6% |
| **Spain** | 20,682 | 6.7% |
| **USA** | 10,835 | 3.5% |
| **Zimbabwe** | 9,457 | 3.1% |
| **Rest of World** | 50,874 | 16.4% |

Source: GTIS Inc Data associated with New Mexico Chile Task Force Reports

Another approach is to consider the scale of the market in the USA to draw some insights from the segmented data.

***Table 2. Value of Paprika - USA - 2003***

| | **Imported** | | **Exported** | |
|---|---|---|---|---|
| | **Value (US$m)** | **Volume mt** | **Value (US$m)** | **Volume mt** |
| **Paprika** | 114.7 | | | |
| **Paprika Oleoresin** | 12.3 | 359 | 10.3 | 1,150 |
| **Fresh and Chilled (all categories of Chile Peppers)** | 547.4 | 426,166 | 79.4 | 72,084 |

The USA represents a dominant world market for all aspects, importer, exporter, major producer for home consumption.

Further statistical break-down are shown in tables in ATTACHMENTS.

## Importers of paprika production

***Table 3. Value of Paprika - USA - 2003***

**Major Importing Markets of Paprika (dried or ground) 2004**

| ***Country*** | ***Percentage of Total*** |
|---|---|
| USA | 23.8 |
| Others | 28.6 |
| Malaya | 7.6 |
| Germany | 7.0 |
| Mexico | 6.8 |
| Spain | 6.3 |
| Japan | 5.9 |
| South Korea | 5.1 |
| Netherlands | 3.1 |
| UK | 2.9 |
| Sri Lanka | 2.9 |
| | 100.0 |

Total CIF: US$587 m

Total Volume 411,000 tonnes

## The Picture of an Industry

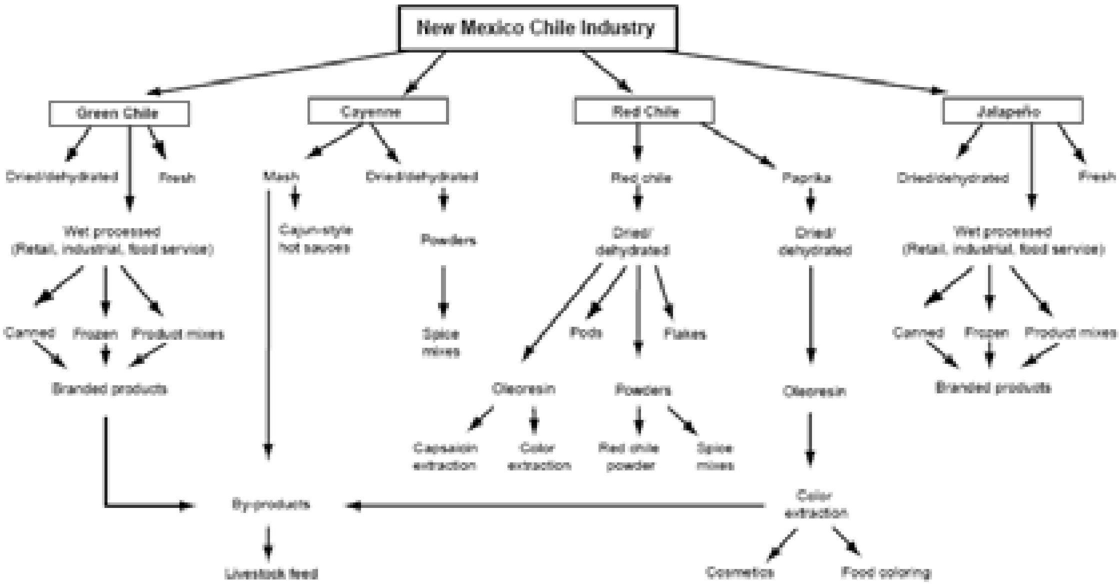



***Figure 2. New Mexico Chilli Pepper Industry Flow Chart***

*(Source: New Mexico Chile Task Force – Report 8)*

The above figure demonstrates the various perspectives from which the industry can be viewed. Degrees of diversity, scale and specialty are key determinant of the ability to be a principal market and industry maker.

Whilst the focus of this report is paprika it is important to be able to view the broader industry in terms of common markets, common processes, application of specialised equipment, cross industry standards and the like rather than necessarily viewing a microcosm of the industry.

# The Australian Market

## Production – the fresh market

Queensland is the main producer of fresh market capsicums and chillies in Australia and supplies the Brisbane, Sydney and Melbourne markets, with smaller quantities going to Adelaide, Perth and other minor markets. Other production centres are around Griffith in NSW, the Riverina, and relatively minor production in Western Australia.

In the year ending 30 June 2005, Queensland produced around 42,156 tonnes of capsicums, chillies and peppers worth about $69.5 million. This is about 89% of the Australian production and 87% of its value, and was grown on 1,973 hectares (Source: ABS estimates).

Capsicums and chillies are also grown for processing on a smaller scale, although much of this production is considered small niche.

High capital costs and buyer requirements for supply from production from a limited number of providers, has tended to cause consolidation to fewer growers producing on a larger scale.

The main production regions are:

- Bowen (April to early November) and
- Bundaberg (April to July and November to early January).
- Lockyer Valley (November to May) and
- Granite Belt (January to April) supply small quantities through summer.

## Production – the future processed market

The potential large scale production areas in Australia may well be supplementary to current “fresh” capsicum production regions. However, the higher scale production for processing is seen as requiring a somewhat different production system, and may therefore be operated under somewhat different circumstances.

Potential new areas may include those areas where due to changing operating constraints such as reduced water allocations may provide a “re-think” of cropping alternatives and therefore open up other regions for consideration, e.g. (but not limited to)

- NW of NSW as a diversification option for some cotton farmers
- Southern NSW and Victorian replacement of some tomato growing

For large scale growing of paprika to establish an industry focused on further value-add is likely to require significant work to identify suitable environments which satisfy all of the preconditions for success.

- climatic
- irrigation
- agronomy
- suitable land costs

as well as some detachment from being regarded as a “vegetable crop” to an “industrial crop”.

## Volume and value of imports

Total imports of paprika are estimated to be less that US$10 million and approximately 4,000 tonnes.

## Potential for an Australian market

The factors that reduce the economic viability of the Australian capsicum/chilli/paprika industry include:

- cost of transplanting seedlings
- the high cost of hybrid seed
- level of hybrid vigour
- the cost of harvesting
- product quality
- genotype x environment interactions for quality and yield

The establishment of a hybrid seed / seedling industry in Australia would remove the limitation imposed by the importation of expensive hybrid seed. There are two approaches that can be considered, these are:

1. The local production of hybrid seed

The purchase of imported hybrid seed is a significant cost to capsicum growers in Australia. An inexpensive local hybrid seed production system would clearly reduce the cost of seed. One approach is to select male sterile plants from segregating populations which are then grown in strips alongside male fertile plants to produce hybrid seed. An alternative method for the maintenance of male sterility is to vegetatively propagate the male sterile plants which are then used to produce hybrid seed in the same way.

Other strategies to propagate male sterile capsicums should be investigated and compared to identify the most cost efficient approach. Matromorphic induction has been shown to stimulate fruit production in diploid plants. Such an approach using tetraploid stocks could be an efficient way to generate diploid male sterile seedlings. Subjecting male sterile plants to environmental extremes can restore male fertility in other food crops making it possible to maintain male sterile lines (particularly cms). This approach could be investigated in capsicum.

2. The production of hybrid seedlings from tissue culture.

Members of the genus *Capsicum* are typically recalcitrant in *in vitro* culture. However, associated research has not been extensive and the development of effective tissue culture methods would significantly reduce the costs associated with the commercial production of hybrid crops. Once optimal heterotic combinations of parental materials have been established, the F1 progeny could be greatly increased through cell culture to produce seedlings for direct transplant. This would remove the need to maintain male sterile stocks and the costs associated with the production of hybrid seed in the field. This method has the distinct advantage of allowing greater investment in the search for optimal heterotic combinations.

Other factors to consider in the establishment of an effective local hybrid seed/seedling industry are:

3. Direct sown hybrid seed

If an effective local hybrid seed industry is established then seed that could be sown directly into the field would further reduce cost by removing the need to raise and transplant seedlings. Seeds could be direct sown using a vegetable seed planter and thinned later if required. Selection for more vigorous larger seeded genotypes and screening for improved emergence may enable genetic gains in this area.

4. Improved mechanical harvesting

Snap off pedicel and fruit detachability genes are present in the genus *Capsicum.* The introduction of these genes into adapted capsicum germplasm would allow the economic benefits of mechanical harvesting to be evaluated. Effective mechanical harvesting would significantly reduce the cost of production. Producing plants with a determinant habit would also facilitate harvesting as the bulk of the fruit would be ready for harvest at the same time. All currently grown cultivars tend to be non-determinant which complicates mechanical harvesting. There are sources of determinant habit in the Capsicum gene pool that could be used to improve this characteristic in cultivars.

5. Cultivar x environment interaction and new areas of production

If the above research areas are addressed then the scope of production within Australia could be expanded from the coastal fringes into inland irrigation areas as mentioned earlier. This would likely require a different plant type and the expression of heterosis would likely be different. The performance of capsicum germplasm would need to be assessed in these regions and suitable breeding parents identified for the establishment of a viable seed/plantlet industry. The market focus of the industry may also change. For example, if paprika is to be grown successfully will the market target be oleoresin or the production of high quality powder? Determining the extent of genotype x environment interaction for product quality and yield will be an important determinant of the potential scale of the industry.

The above research outline describes the avenues available for developing an effective hybrid seed industry. However, should the issues of detachability, seed size and determinant habit be addressed it is highly likely that inbred cultivars will successfully compete with F1 hybrids as their cost of production will be lower.

## Who are the current and likely consumers

Current users of imported paprika products are principally confined to the manufactured food sector, beverage and food service sector. This sector continues to have growth of prepared foods, including, processed meats and sausage, pizza and salsas foodstuffs. This sector is also dominated by major multinational corporations.

Consumption of foods using such additives for flavour and colourings is likely to increase reflecting such changes to eating preferences and internationalising of cuisines and increasing use of prepared foods and increased use of natural rather than artificial additives.

With increasing concerns about artificial ingredients used in cosmetics and demand for natural products, pigments and oleoresins from sources such as paprika. The nature of the manufacturing companies involved in this sector are very wide-ranging, from niche product developers to global cosmetic brand companies. The main implications are that such demand may be satisfied through targeted marketing and matching of targeted specification, thus creating a differentiated market opportunity for producers. At the core of this identification of new customers will be relationships which satisfy demands such as quality, security and reliability criteria.

From a regional perspective Japanese cosmetic industry may well be a prime target.

## Can Australia produce the quality expected

Arguably there is a state-of-the-art plant breeding capacity in Australia, which can over time respond with creation of suitable cultivars which exhibit the required quality attributes which are necessary to fulfil demands. However, Australia does not have a vigorous paprika growing industry and therefore the opportunities to improve quality traits and adaptation has not necessarily been an industry priority, and as such, is not seen as the prime limitation to creating an industry.

However, if there were to be an industry of any scale there would be a significant incentive to create quality enhanced and well adapted germplasm.

The challenge for plant breeders is seen at least in the near term to identify appropriate growing environments suitable for large scale paprika growing and apply their skills to that circumstance. Previous research carried out at the Plant Breeding Institute has developed and achieved Plant Breeders' Rights over new cultivars which compare favourably with alternatives.

Creating quality paprika and resultant crop products and enhancing those seems to be more a challenge of responsiveness rather than a primary driver of the establishment of an industry.

Quality attributes also are not limited to the plant alone, it is the background regulatory and controls over the industry are also important determinants of quality. Australian standards in this regard are high, and certainly higher than many of the production systems of overseas suppliers.

# Processing and Extraction

## Can Australia extract oleoresin competitively?

There are current capacities in Australia which successfully operate technologies for the extraction of oleoresins. The extent to which these are applied to current production of paprika oleoresins is niche and minor.

The challenge is more to match a particular need with a particular solution. There are companies which have trialled the extraction of paprika oleoresin on laboratory scale only, and produced an acceptable product. However, most trialling involves the adaptation of other applications and as such cannot necessarily be considered as totally representative of a system which may apply if fully purpose designed and implemented.

For a viable paprika business to be established one has to make some assumptions as to the nature of that business and how it may interact in the market place. In this particular situation it is unlikely that a future paprika based business will be anything other than a vertically integrated structure from the establishment, and therefore will be purpose designed throughout the entire process.

With the above as a key assumption, a purpose built oleoresin extractive process may either be a standard technology or in fact contain new technologies and purpose-adapted.

## Methods and extraction

Previous studies associated with the research conducted by the University of Sydney and by Invetech (report: *Commercialisation Potential of Paprika Technology 2004*) identified several extractive systems. These include:

- Hydrocarbon based solvent
- Flourocarbon based solvent
- Super-critical CO2
- and others

It is premature to speculate on what process is likely to be the most relevant system for any potential paprika products as this entirely depends upon such factors as:

- the regulatory position at the time and the desire to phase out some usages of systems being seen as damaging to the environment and potential risks in the food chain products,
- the particular targeted markets for the products
- the specific nature of the paprika grown and pre-processed
- the degree and preparedness to further innovate to find new solutions and technologies to exploit the opportunity.

Also a significant difference will be whether a potential extractive process will be incorporated into the total venture to make a vertically integrated business unit rather than a series of separate businesses. Should a vertically integrated business be created it is suspected there would be a better chance of capturing a greater degree of total benefits available rather than each phase of business being separate “toll-based” deliveries.

# The Value Chain

## What are the barriers and options for developing an oleoresin ‘value chain’ in Australia.

The key barriers to developing a profitable industry are seen to include:

- Need for export focus
- Need to fund “front-end” value-add processing to “pull” crop production in to being
- Creation of scale projects
- Identification of most suitable capital equipment
- Facilitation of cropping change or part diversification (e.g. from cotton to paprika)
- Identification of the most suitable environments in which to operate

A key proposition is that in order to achieve success in the establishment of such an industry it must be developed on the basis of a fully implemented value chain, and not just seen as the crop growing for sale to others to value add to that production.

To simply view the industry in terms of growing a quality commodity crop of paprika for export in an unprocessed form places the product in competition with the lowest cost and third world producers, this is not a desirable, nor preferred, or rational strategy.

However, to initiate strategies which grow paprika crops and value add prior to export significantly alters the value proposition and likelihood of success, and places the industry into a different competitive class. Having achieved such a differentiation of competitive positioning the industry can set about re-branding and specifying product attributes such as quality traits for which premiums may be attracted.

## An example model - integration

There are successful companies growing, processing and marketing products world-wide. One such company in Israel is Negev Spices.

A key feature of the business is the designing-out of labour, at essentially all phases of the process and replacement via appropriate technology to fulfil all the tasks.

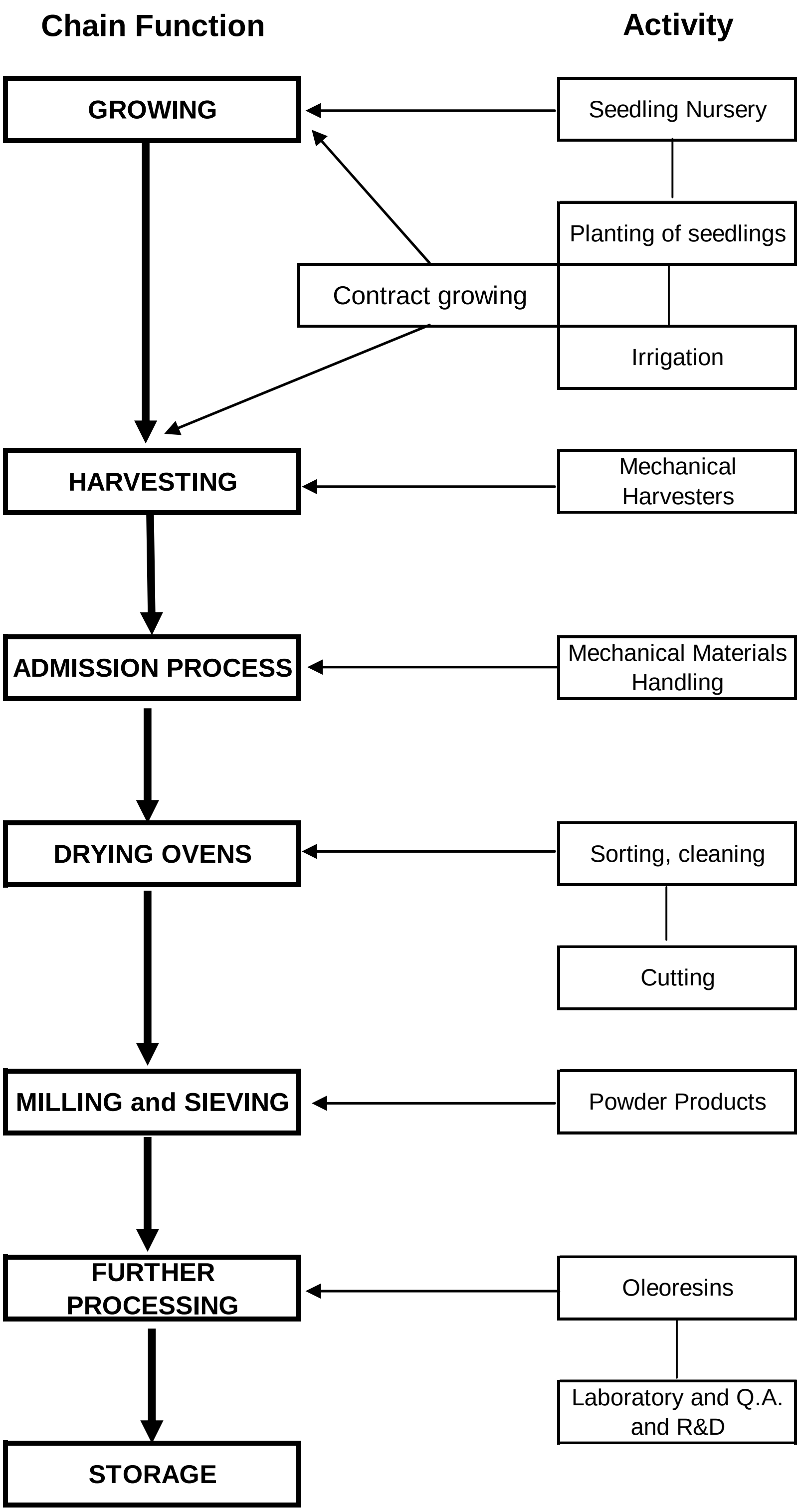



***Figure 3. Flow Diagram of Paprika Production***

There are significant benefits to be derived from taking a holistic systems view of the enterprise. Costs are reduced through design out of labour and elimination of organisational duplication.

Quality assurance is enhanced by control over all elements of the process chain. Innovation applied at all levels is part of the solution.

In order to justify the relatively higher capital costs of establishment positioning is critical.

For a country such as Australia it is probably more beneficial to attempt to position an enterprise at the top end of an industry which employs all the necessary technologies focused on efficiencies in order to compete in the world markets, or targeted overseas niches..

By industrialising the entire value chain greater opportunity should be accessed for growth, whether by scale or diversity of market product development.

The strategic decision to design a complete process essentially pre-determines what class of competition any enterprise is to face. It is somewhat harder to retro-fit an industrialised process to fragmented elements of the production chain.

In the Australian context, there are no benefits to be derived from production and supply of low commodity grade product, rather products constituting higher goals should be set.

## The Enterprise Model and economic scale

### The Model

With some degree of speculation, the following represents a hypothetical model which may be useful for others to consider. The model addresses and contains a number of key assumptions considered important in enterprise risk appraisal and preconditions to attract venture capital.

The model of the business enterprise must have the following attributes (amongst others) as pre-requisites for success:

- it must be viable and operate without any major subsidy being relied upon
- the initial installed capacity functions must be a complete value-adding unit rather than a staged implementation of cropping system and then (later) a processing capacity.
- the structure should facilitate micro-regional cooperation or joint ventures such that growers are collaborators and not competitors.
- farm and processing equipment must be state of the art, and be designed for the specific circumstances

The model described above is not dissimilar to the models for the establishment of the cotton industry (albeit on a smaller scale) in the NW of NSW some 30 or 40 years ago where the second generation development was created in small market efficient micro-regional units often set up outside the “cooperatives” by well resourced innovative producers who identified the value added opportunities in the market-place.

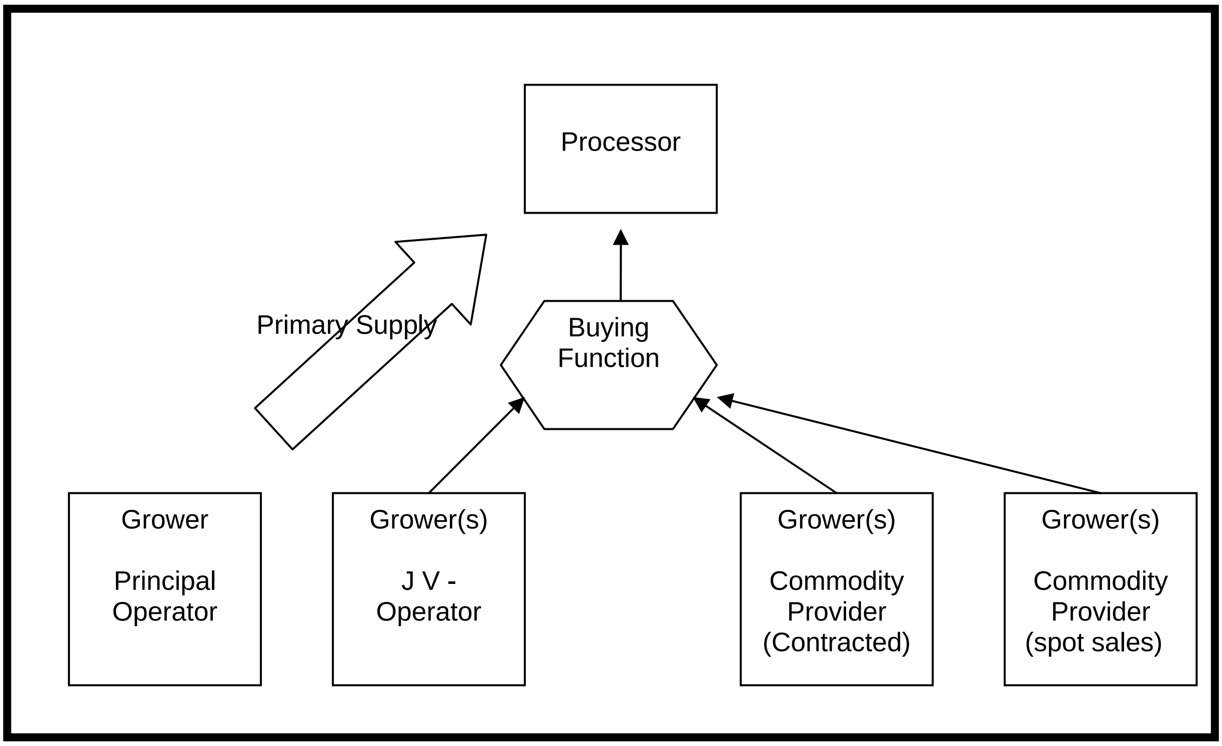



***Figure 4. A micro-regional model: Paprika Enterprise and suppliers***

It is somewhat of an unlikely scenario that large scale broadacre plantings of paprika for the unprocessed commodity to be embarked on in this industry. Rather, it is more likely that a scenario of an entity or small group will embark on setting up infrastructure to value-add to any crop as a means to capture more of the value chain margins that are available, to coincide with first year cropping.

The decision to invest in such a Paprika growing and processing enterprise is likely to contain a couple of important steps:

1. The decision to evaluate an alternate crop

   Growers typically make these decisions regularly. These decisions fall into two categories:

   - Alternate crops requiring unaltered equipment e.g. wheat to another grain crop
   - Alternate crop requiring new equipment e.g. wheat to cotton

2. The decision to grow an alternate crop and value add

   Here the decision can be somewhat two-dimensional, in that the possibilities include:

   - Alternate crop which satisfies an economic enhancement over current crop, AND
   - Extra margins gained via the addition of installation of new value-adding processes and equipment.

   *Note: the "AND" is emphasised here because it would be hoped that anyone establishing an enterprise would seek to be able to enhance throughput of the value-adding phases by accepting production from other growers. If the new crop of Paprika did not demonstrate superior returns over current crops then the implication is that growth of the value-adding may be limited, and thereby put further doubts as to viability.*

## The Profile of Venturers

It may assist to speculate on possible drivers and profiles of what type of operator will take up the challenges of an emerging opportunity to establish a paprika growing and processing unit.

1. Diversification

   Diversification is a strong driver, and particularly throughout the more successful rural operators and corporations who seek to maximise returns from the available assets and resources. There are many examples of successful diversification encompassing (say) cereal cropping, cattle, and cotton – together with the value adding activities of feedlotting and abattoir, cotton gins etc. Such diversification seeks both vertical integration as well as product diversification.

2. Skilled Paprika Operators

   Due to market dislocations in other countries where political instability has caused skilled flight migration such individuals may seek to identify agricultural projects which capitalise on specific market skills which could make market access and participation in existing supply-chain networks easier than may otherwise be the case.

   Often it is a matter of providing access to local producer organisations and networks to explore the opportunities.

3. Niche operator marketer

   At present there are a relatively small number of niche operators in spice. Participation in an enterprise as described above may represent a substantial jump in scale and market positioning.

4. Offshore (Buying) Organisation

   Another group may come from significant scaled buyers who are seeking to source product from an agricultural system which has higher standards and reliability than some of the poorer quality networks such as China, India and SE Asia. Of course, this may assume some lenience and acceptance of “quality vs premium prices” equations.

## The Economic Scale

A likely economic scale using the above Enterprise Model as a guide could possibly be determined by assuming a product capture from say between 600 and 1,000 ha. which would represent a processing design scale of say between 3,000 and 6,000 tonnes of dry matter.

A scale such as this allows for some flexibility to be gained, due to:

- It is sufficiently large to attract like-minded growers to into a joint venture of sufficient scale to make money.
- assuming that any joint venture may be made up of a principal project initiator and two or more other parties (early adopters), each could contribute the crop production of around 100-200 ha of paprika to underpin the project. At this scale some sharing of any specialist field equipment may be possible as well, further optimising cost inputs.
- Further capacity could be brought on-stream by (follower adopters) via second stage growth of capacity within joint venture or as contracted producers.
- An end market user may also be attracted to the venture as a vertical integration of their operations and value chain.

There is some merit in a joint venture approach for establishment, rather than a project to be relying essentially on a single person or entity, a small group is seen as having risk mitigation and also opens up more access to the capital requirements.

The design capacity of the business may be structured consisting:

(Note: it is assumed that land and basic infrastructure is already in place, tractors irrigation storage etc, and that the following represent the paprika specific infrastructure needs).

- In the field: drip or furrow irrigation
- Harvester: Mechanical Harvester range from $100,000 to $450,000 imported models in common use in north America. Local adaptations of other machines may work, e.g. modified tomato or cotton pickers, may provide cheaper alternatives.
- Material Handling, Dehydrators, Processing and Milling: (say) $1,500,000.

## Further Modifications of the Enterprise Model

Having determined the capital equipment “ball-park” scale for a start-up operation, this can be further differentiated to segregate and modify some of the risks.

Assuming that some form of joint venture and corporate structure were to be established the capital requirements (excluding land) may be represented by either of the following:

Enterprise Model A – all principal functions

A start-up capital requirement of about $4-5 million would be required to support a growing and processing of say 3-5,000 tonnes crop and processing. Whereby the enterprise is responsible for the growing of crop.

Enterprise Model B – principal processing functions without grower risk

A start-up capital may be reduced to say $3 million whereby the joint venture is confined to functions of processing and marketing of the products. The analogy may be three or four cotton farmers agree to build and jointly own cotton ginning capacity as a value-added activity. Some of the enterprise risk is transferred back onto the investing participants.

To an extent this model may be easier to fund than an aggregated model “A” where risks tend to compound somewhat.

## Building projections for a planned Paprika Enterprise

A future enterprise could take many forms based on the end product.

Overseas experience suggests that there are two primary end products:

- Dry powdered paprika - some 60%
- Paprika oleoresin - some 40%

The two systems have essentially common "front-end" processing requirements but differing end processing requirements.

The oleoresin processing does require supplementary equipment and therefore is more expensive, however, the products open avenues to access higher value end markets in dyes and cosmetics.

Conceptually, it may be an easier task to define a two-stage business plan which initially concentrates on achieving an establishment of a production system which focuses on higher quality dry powder exports and then at a later stage address value-adding enhancements which capture other higher value markets which also have additional technical barriers, such as premium qualities and very high ATSA products.

It may well be beneficial to establish a higher scale of production in order to attract sufficient grower participants to create critical mass and market presence, and only then seek higher margins with additional value adding activities and processes.

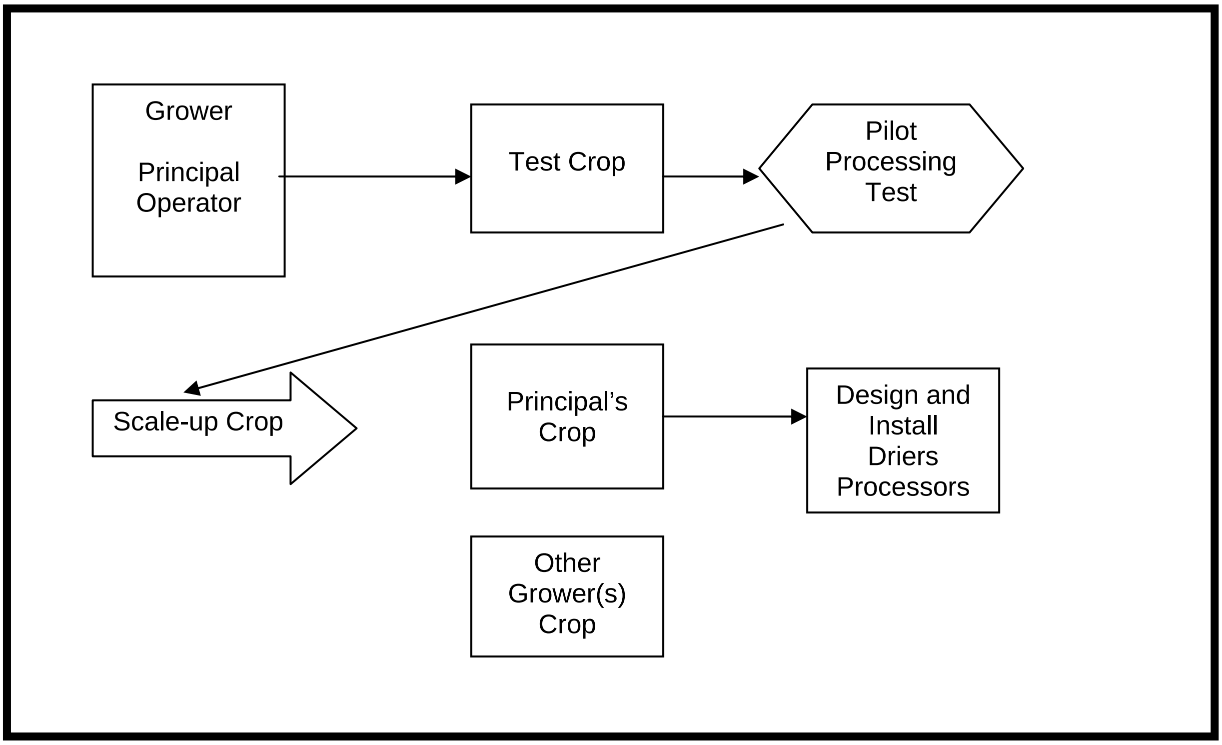



***Figure 5. Establishment Phases***

## How can RIRDC/Sydney University assist in overcoming the barriers?

To-date much of the research that has been carried out in recent years at the Plant Breeding Institute by researchers such as Prof. N. Derera, Dr N Nagi and others, have focused on the breeding of cultivars considered at the time to be relevant to improving quality traits which include high ASTA and breeding for improvement to "detachability" characteristics which facilitate better mechanical harvesting of the fruit, together with early attempts of a hybridisation system.

Whilst the above may be seen as important in themselves, they do not necessarily lead to large leaps towards establishment or facilitation of the broader industry.

The focus for the time being should shift to other priorities relevant to eliminating some of the investment risk and also activities which may further reduce some costs associated with production.

Specific areas where The University of Sydney can assist in the future in overcoming some barriers, include:

- Evaluation of the most suitable growing environments for paprika which fully satisfy the criteria for large scale crop production and centralised processing.
- **Agro-economic Studies -** Economic study to demonstrate viability of alternate cropping systems, together with where they may specifically apply. The University of Sydney is currently conducting agro-economic research into some "cotton to wheat" to combat the impact of lower water allocations.
- **Grow-out Trials -** Suitability location grow-out trials for paprika. There is anecdotal evidence that paprika may be suitable in several locations which might be conducive to economically viable scale production which may support a closed paprika value-added network.

  By taking the currently available (and considered relevant) germplasm of several cultivars, it would be proposed that several small grow-out trials be conducted just to verify comparative performance under different environmental conditions.

  Trial sites (5 or 6) may be considered from the Murray in the south to above the Queensland border west of the Newell Highway.

  Some of the results may lead to interesting insights into correlations of:

  - increase in ASTA values and warm nights as one moves north
  - multi-crop per year per site information

The work above may be seen as quite basic, however, it is considered that this fundamental approach may achieve several things, including:

- a re-setting of breeding targets for improved cultivars
- an engagement with producers for interest creation within relevant farming systems and crop alternatives

- **Work Shops -** Facilitated assistance to would-be investors who may be considering investment in the value-add paprika complex. This could be in the form of "Work Shops" which aim to facilitation of network establishment, which may possibly lead to joint ventures or resource availability.
- **Somatic Hybridisation -** A final aspect to consider for innovation to reduce costs of production associated with paprika is an alternate approach to hybridisation systems to include somatic hybridisation. If successful, there would be an immediate ability to transfer the technology solutions to other capsicums (bell, chilli etc) and thereby impact on a broader range of Australian enterprise.

> The objective would be to have already identified the most suitable cultivars for the paprika cropping requirements and markets, and be able to move directly to seedling stage in a cost-effective manner.

With changes to the management responsibilities of the paprika breeding program within the Plant Breeding Institute to Prof. Richard Trethowan recently has brought an opportunity to review the basic strategies. The current strategy in respect of paprika is to conduct a review of currently available germplasm just “to see what we have got”. This will entail some grow out activities in the Spring which may then lead to a new process of selection and breeding aims.

It is the intention of the Plant Breeding Institute to continue to foster interest by industry participants in the potential of a paprika growing and processing, networking is seen as a key element and potential driver.

## Summary Action Plan

In order to achieve the broader objectives of the development of a viable "value-added" paprika industry less emphasis should be placed on attempting to identify "likely winners" in preference to attempt to facilitate assistance to those commercial entities which recognise an opportunity and can adapt a business strategy which delivers desired outcomes.

The most beneficial assistance that can be delivered to the industry is to identify certain opportunity components from which commercial entities can plan and assess investment risk.

There is little doubt with an appropriate degree of determination and innovation, industries can create spectacular growth, albeit from a low base, to become significant participants within any given industry. Whilst there has been a somewhat spectacular growth in Peru associated with paprika, capsicum and chilli it may be more appropriate to focus on the growth experiences and strategies adopted in states such as New Mexico and Israel where growth has been achieved by focusing on dealing with and overcoming the industry and practice constraints.

In Australia there are several options. If there is to be growth in the industry in what form is it likely to be?

- Growth in current production centres
- Growth from new production centres, which may be justified on the basis of solving problems associated with other cropping systems need to be considered. There may be opportunities to consider the relative benefits of providing cropping alternatives to producers of cotton. If viable this would open up significant potential for the north west of NSW in particular.

## Planning

It is somewhat premature to even speculate on the scale, nature, profitability of any potential enterprise which may be established. However, it is probably also fair to say that without adopting a capital intensive approach to such an enterprise any venture is unlikely to succeed.

The critical elements for establishment of a viable paprika production and processing industry are considered to be:

1. A grow-out trial using available germplasm to identify suitable environments for large scale paprika production.
    - identification of "best or most suitable" environment sets the parameters for both cost of production and likely participants
2. Facilitation of a seeding for a consortium to commence enterprise and business planning
    - bringing parties together for networking opportunities
    - initiation of planning for business due diligences based on commercial experiences
        - production
        - processing
        - plant and process design
        - commercial trialling of processes

Commercialisation of a paprika industry is still very much in an infant stage, however, if it is to occur it must be driven from within, and evolve under normal commercial circumstances. Networking is about the most effective mechanism to act as a catalyst for development.

# Attachments

# 75030DO001_200506 Value of Agricultural Commodities Produced, Australia, 2005-06
Released at 11:30 am (Canberra time) Thurs 8 May 2008

## Table 3 GROSS VALUE, Vegetables–year ended 30 June 2006

| | 2006 NEW BASIS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **NSW** | **Vic.** | **Qld** | **SA** | **WA** | **Tas.** | **NT** | **ACT** | **Aust.** |
| | $m | $m | $m | $m | $m | $m | $m | $m | $m |
| Asparagus | 0.8 | 43.7 | 0.9 | 0.0 | 1.1 | 0.0 | 0.0 | 0.0 | 46.6 |
| Beans, french and runner | 5.0 | 11.3 | 61.9 | 0.2 | 6.1 | 4.9 | 0.0 | 0.0 | 89.3 |
| Beetroot | 0.6 | 0.3 | 7.6 | 0.2 | 0.6 | 0.1 | | 0.0 | 9.5 |
| Broccoli | 7.1 | 38.4 | 16.8 | 2.1 | 16.4 | 5.6 | 0.0 | 0.0 | 86.5 |
| Cabbages | 13.5 | 21.0 | 14.5 | 5.9 | 6.3 | 1.0 | 0.0 | 0.0 | 62.2 |
| **Capsicums and chillies** | **1.7** | **8.3** | **143.2** | **12.5** | **11.2** | **0.9** | **0.3** | **0.0** | **178.0** |
| Carrots | 6.8 | 24.0 | 15.0 | 49.2 | 35.1 | 26.3 | 0.0 | 0.0 | 156.4 |
| Cauliflower | 8.0 | 21.0 | 9.5 | 7.2 | 3.8 | 3.4 | | 0.0 | 53.0 |
| Celery | 0.0 | 25.6 | 4.7 | 4.8 | 5.6 | 0.4 | 0.0 | 0.0 | 41.1 |
| Cucumbers | 11.8 | 1.1 | 22.9 | 10.8 | 12.8 | 0.1 | 0.4 | 0.0 | 59.9 |
| Green peas | 0.8 | 1.3 | 1.0 | 0.1 | 0.3 | 6.2 | 0.0 | 0.0 | 9.6 |
| Lettuces | 27.7 | 49.9 | 58.1 | 11.5 | 8.6 | 2.7 | 0.4 | 0.0 | 159.1 |
| Melons | | | | | | | | | |
| Rock and cantaloupe | 22.3 | 5.6 | 35.5 | 2.0 | 23.4 | 0.0 | 4.1 | 0.0 | 92.8 |
| Water | 14.3 | 2.2 | 39.1 | 0.7 | 10.3 | 0.0 | 4.9 | 0.0 | 71.5 |
| Mushrooms | 63.4 | 73.5 | 57.2 | 18.7 | | | 0.0 | 0.0 | 243.8 |
| Onions | 12.5 | 7.8 | 20.7 | 62.6 | 13.9 | 27.6 | 0.3 | 0.0 | 145.3 |
| Parsnips | 0.6 | 6.8 | 0.0 | 6.1 | 1.9 | 0.7 | 0.0 | 0.0 | 16.0 |
| Potatoes | 49.3 | 117.1 | 46.9 | 135.9 | 40.5 | 73.7 | 0.0 | 0.0 | 463.5 |
| Pumpkins | 21.5 | 2.0 | 33.4 | 2.7 | 19.9 | 0.9 | 0.4 | 0.0 | 80.8 |
| Sweet corn | 5.8 | 11.8 | 36.0 | 0.6 | 5.8 | 0.1 | 0.0 | 0.0 | 60.1 |
| Tomatoes | 19.7 | 74.7 | 145.2 | 13.6 | 18.6 | 0.8 | 0.2 | 0.0 | 272.8 |
| Zucchini and button squash | 6.0 | 3.3 | 57.5 | 0.8 | 4.0 | 0.0 | 0.1 | 0.0 | 71.7 |
| Other vegetables n.e.i. | 59.7 | 84.8 | 117.3 | 40.2 | | | 3.4 | 0.2 | 363.7 |
| **Total vegetables** | **358.8** | **635.6** | **945.0** | **388.3** | **292.4** | **198.5** | **14.4** | **0.2** | **2,833.4** |

**(Source: ABS)**

**Table 3 Agricultural Commodities Produced, Gross Unit Value–Year ended 30 June 2006**

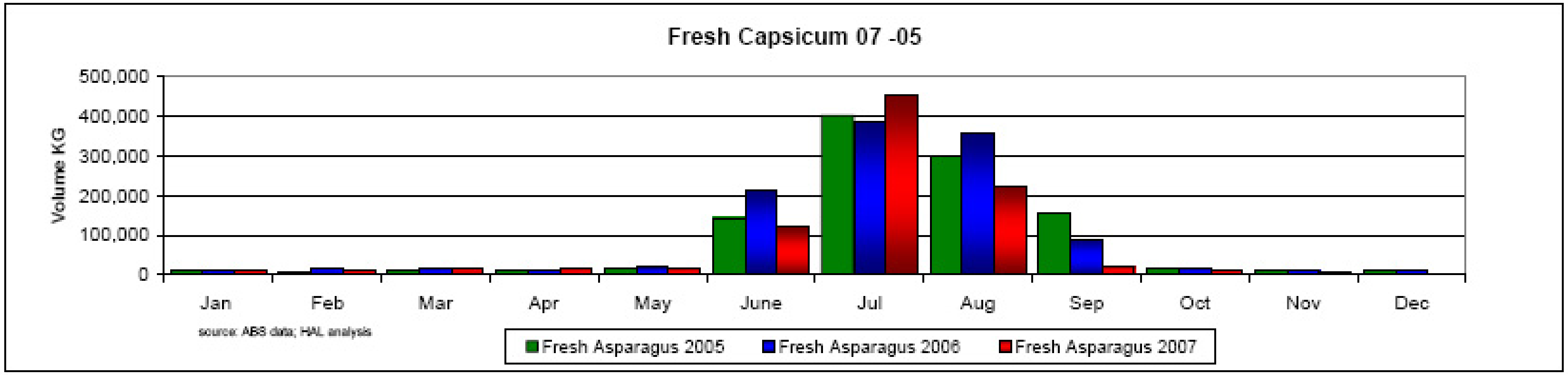
## 75030DO003_200506 Value of Agricultural Commodities Produced, Australia, 2005-06 (Additional Datacubes)

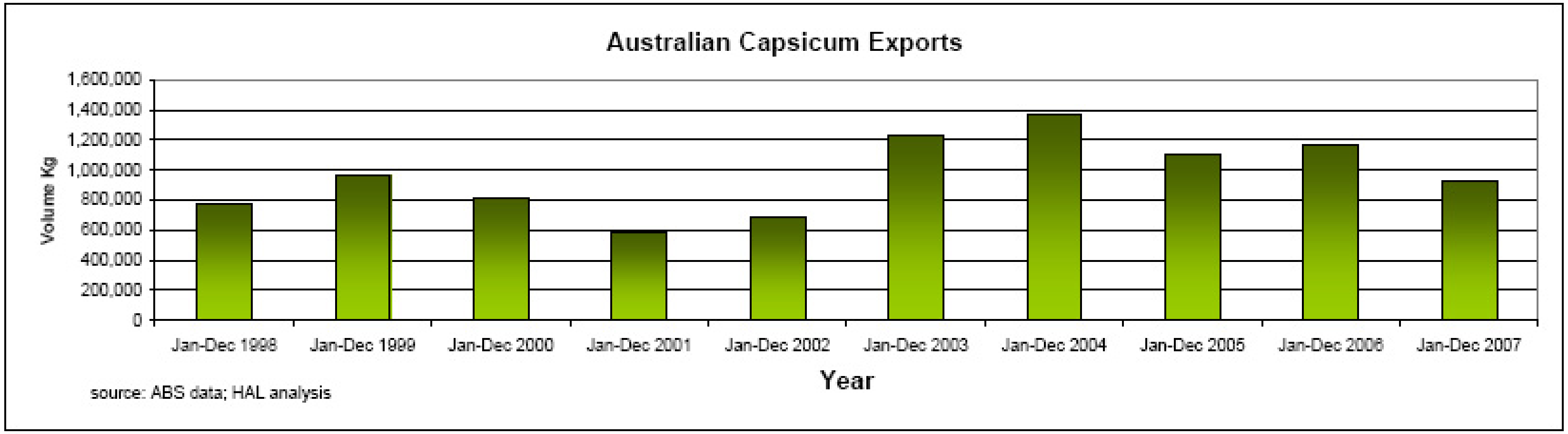
Released at 11:30 am (Canberra time) Thurs 8 May 2008

**Table 3 Agricultural Commodities Produced, Gross Unit Value–Year ended 30 June 2006**

| | 2006 New Basis | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | NSW | Vic. | Qld | SA | WA | Tas. | NT | ACT | Aust. |
| Vegetables | | | | | | | | | |
| Asian vegetables ($/kg) | 3.96 | 3.99 | 4.53 | 6.47 | 3.40 | 3.99 | 3.75 | 3.96 | 4.09 |
| Asparagus ($/t) | 5,227 | 4,667 | 9,501 | 5,550 | 10,158 | 5,398 | 0 | 0 | 4,787 |
| Beans, french and runner ($/kg) | 3.42 | 2.98 | 3.14 | 4.26 | 5.46 | 0.41 | 3.75 | 0.00 | 2.36 |
| Beetroot ($/t) | 191 | 313 | 240 | 940 | 2,102 | 1,869 | 0 | 0 | 260 |
| Broccoli ($/kg) | 2.08 | 1.73 | 1.64 | 2.06 | 2.84 | 0.98 | 0.00 | 0.00 | 1.79 |
| Cabbages ($/t) | 677 | 872 | 712 | 846 | 1,081 | 759 | 736 | 0 | 792 |
| Capsicums ($/kg) | 1.88 | 2.60 | 2.77 | 4.55 | 2.73 | 2.82 | 3.05 | 0.00 | 2.83 |
| Carrots ($/t) | 278 | 579 | 678 | 819 | 566 | 480 | 0 | 0 | 590 |
| Cauliflowers ($/t) | 698 | 712 | 631 | 839 | 688 | 533 | 0 | 0 | 692 |
| Celery ($/kg) | 0.78 | 0.77 | 0.86 | 1.09 | 0.78 | 0.60 | 0.00 | 0.00 | 0.81 |
| Cucumbers ($/kg) | 2.26 | 3.02 | 2.25 | 2.93 | 3.60 | 1.94 | 2.20 | 0.00 | 2.57 |
| Green peas (pod weight) ($/kg) | 4.05 | 3.89 | 4.27 | 3.68 | 0.80 | 0.38 | 0.00 | 0.00 | 0.54 |
| Lettuces ($/t) | 931 | 850 | 1,093 | 1,517 | 771 | 1,291 | 1,890 | 0 | 977 |
| Melons - rock and canteloupe ($/t) | 1,044 | 943 | 1,097 | 845 | 1,158 | 0 | 1,398 | 0 | 1,091 |
| Melons - watermelons ($/t) | 541 | 542 | 533 | 540 | 653 | 0 | 378 | 0 | 534 |
| Mushrooms ($/kg) | 4.22 | 5.74 | 7.95 | 5.43 | 6.06 | 5.79 | 0.00 | 0.00 | 5.59 |
| Onions ($/t) | 647 | 744 | 756 | 775 | 932 | 401 | 1,207 | 0 | 655 |
| Parsnips ($/t) | 900 | 867 | 0 | 4,174 | 3,246 | 3,005 | 0 | 0 | 1,488 |
| Potatoes ($/t) | 377 | 405 | 502 | 380 | 453 | 256 | 0 | 0 | 371 |
| Pumpkins ($/t) | 700 | 650 | 709 | 539 | 885 | 471 | 680 | 0 | 729 |
| Sweet corn ($/t) | 241 | 1,381 | 1,285 | 1,747 | 2,167 | 991 | 0 | 0 | 943 |
| Tomatoes ($/t) | 260 | 305 | 1,336 | 2,200 | 1,352 | 1,430 | 3,000 | 1,139 | 606 |
| Zucchini and button squash ($/kg) | 2.79 | 1.50 | 3.42 | 2.13 | 3.49 | 1.50 | 1.44 | 0.00 | 3.15 |

**(Source: ABS)**


Fresh Capsicum 07 -05
Volume KG
500,000
400,000
300,000
200,000
100,000
0
Jan
Feb
Mar
Apr
May
June
Jul
Aug
Sep
Oct
Nov
Dec
source: ABS data; HAL analysis
Fresh Asparagus 2005
Fresh Asparagus 2006
Fresh Asparagus 2007


Australian Capsicum Exports
Volume Kg
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
Jan-Dec 1998
Jan-Dec 1999
Jan-Dec 2000
Jan-Dec 2001
Jan-Dec 2002
Jan-Dec 2003
Jan-Dec 2004
Jan-Dec 2005
Jan-Dec 2006
Jan-Dec 2007
Year
source: ABS data; HAL analysis

**Bell Peppers for Fresh Market and Processing: Area Planted and Harvested,**
**Yield, and Production by State and United States, 2001-2003**

| State | Area Planted | | | Area Harvested | | |
|---|---|---|---|---|---|---|
| | 2001 | 2002 | 2003 | 2001 | 2002 | 2003 |
| | Acres | | | | | |
| CA | 22,000 | 19,300 | 20,500 | 22,000 | 19,000 | 20,500 |
| FL | 16,000 | 17,600 | 17,400 | 15,700 | 17,500 | 17,300 |
| GA | 2,200 | 2,700 | 2,900 | 2,100 | 2,600 | 2,700 |
| MI | 1,900 | 1,800 | 1,800 | 1,400 | 1,600 | 1,800 |
| NJ | 3,700 | 3,700 | 3,600 | 3,700 | 3,700 | 3,600 |
| NY 1/ | 700 | | | 640 | | |
| NC | 7,000 | 7,400 | 7,000 | 6,300 | 7,000 | 6,000 |
| OH | 2,100 | 1,700 | 2,200 | 2,000 | 1,600 | 2,000 |
| PA 1/ | 400 | | | 380 | | |
| TX | 1,200 | 900 | 800 | 1,100 | 800 | 700 |
| VA 1/ | 1,000 | | | 700 | | |
| US | 58,200 | 55,100 | 56,200 | 56,020 | 53,800 | 54,600 |

| State | Yield per Acre | | | Production | | |
|---|---|---|---|---|---|---|
| | 2001 | 2002 | 2003 | 2001 | 2002 | 2003 |
| | Cwt | | | 1,000 Cwt | | |
| CA | 325 | 370 | 375 | 7,150 | 7,030 | 7,688 |
| FL | 345 | 300 | 280 | 5,416 | 5,250 | 4,844 |
| GA | 200 | 200 | 300 | 420 | 520 | 810 |
| MI | 260 | 250 | 250 | 364 | 400 | 450 |
| NJ | 320 | 260 | 245 | 1,184 | 962 | 882 |
| NY 1/ | 230 | | | 147 | | |
| NC | 125 | 130 | 100 | 788 | 910 | 600 |
| OH | 125 | 210 | 295 | 246 | 336 | 590 |
| PA 1/ | 76 | | | 29 | | |
| TX | 250 | 200 | 250 | 275 | 160 | 175 |
| VA 1/ | 61 | | | 43 | | |
| US | 287 | 289 | 294 | 16,062 | 15,568 | 16,039 |

(Source : USDA )

| State | Value: Per Cwt 2001 | Per Cwt 2002 | Per Cwt 2003 | Total 2001 | Total 2002 | Total 2003 |
|---|---|---|---|---|---|---|
| | Dollars | | | 1,000 Dollars | | |
| CA | 25.50 | 28.50 | 28.80 | 182,343 | 200,618 | 221,122 |
| FL | 34.40 | 34.40 | 35.90 | 186,310 | 180,600 | 173,900 |
| GA | 28.00 | 20.00 | 30.00 | 11,760 | 10,400 | 24,300 |
| MI | 22.00 | 24.00 | 22.00 | 8,008 | 9,600 | 9,900 |
| NJ | 23.50 | 27.20 | 29.00 | 27,824 | 26,166 | 25,578 |
| NY 1/ | 40.90 | | | 6,012 | | |
| NC | 20.50 | 22.00 | 25.00 | 16,154 | 20,020 | 15,000 |
| OH | 29.40 | 23.80 | 27.10 | 7,232 | 7,997 | 15,989 |
| PA 1/ | 25.30 | | | 734 | | |
| TX | 40.30 | 47.00 | 32.40 | 11,083 | 7,520 | 5,670 |
| VA 1/ | 30.00 | | | 1,290 | | |
| US | 28.60 | 29.70 | 30.60 | 458,750 | 462,921 | 491,459 |

1/ Estimates discontinued in 2002.



**Chile Peppers for Fresh Market and Processing: Area Planted and Harvested, Yield, Production, and Value by State and United States, 2001-2003 1/ 2/**

| State | Area Planted 2001 | Area Planted 2002 | Area Planted 2003 | Area Harvested 2001 | Area Harvested 2002 | Area Harvested 2003 |
|---|---|---|---|---|---|---|
| | Acres | | | | | |
| AZ | 3,400 | 3,200 | 3,200 | 3,100 | 3,000 | 3,000 |
| CA | 2,600 | 2,800 | 3,000 | 2,600 | 2,800 | 3,000 |
| NM | 19,000 | 18,000 | 15,400 | 17,700 | 16,800 | 13,700 |
| NC 3/ | 650 | | | 650 | | |
| TX | 7,000 | 6,000 | 5,000 | 6,500 | 5,500 | 4,500 |
| US | 32,650 | 30,000 | 26,600 | 30,550 | 28,100 | 24,200 |

(Source : USDA )

| | Yield per Acre | | | Production | | |
|---|---|---|---|---|---|---|
| | 2001 | 2002 | 2003 | 2001 | 2002 | 2003 |
| | ---------- Cwt ---------- | | | -------- 1,000 Cwt -------- | | |
| AZ | 55 | 63 | 70 | 172 | 190 | 210 |
| CA | 225 | 230 | 230 | 585 | 644 | 692 |
| NM | 92 | 115 | 105 | 1,620 | 1,928 | 1,470 |
| NC 3/ | 110 | | | 72 | | |
| TX | 60 | 50 | 50 | 390 | 275 | 225 |
| US | 93 | 108 | 107 | 2,839 | 3,037 | 2,597 |

| | Value | | | | | |
|---|---|---|---|---|---|---|
| | Per Cwt | | | Total | | |
| | 2001 | 2002 | 2003 | 2001 | 2002 | 2003 |
| | --------- Dollars --------- | | | ------- 1,000 Dollars ------ | | |
| AZ | 28.30 | 14.50 | 14.60 | 4,872 | 2,759 | 3,076 |
| CA | 30.30 | 27.90 | 19.30 | 17,697 | 17,948 | 13,388 |
| NM | 29.70 | 25.80 | 25.70 | 48,050 | 49,796 | 37,800 |
| NC 3/ | 25.00 | | | 1,800 | | |
| TX | 43.50 | 40.00 | 60.90 | 16,965 | 11,000 | 13,703 |
| US | 31.50 | 26.80 | 26.20 | 89,384 | 81,503 | 67,967 |

1/ Chile peppers are defined as all peppers excluding bell peppers.
2/ Estimates include both fresh and dry product combined.
3/ Estimates discontinued in 2002.

(Source : USDA )

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